BSHM meeting: Mathematics in Times of Crisis

6 July 2020

PROGRAMME & ABSTRACTS

Provisional programme:

Recorded talks will be released on Sunday 5 July. Allow approx 30 mins for watching each talk.
Links for live Q&A sessions will be sent to registered participants, also on 5 July.

Session 1: Individuals in world events
Richard Simpson (independent): *Paolo Ruffini (1765-1822) - a forgotten talent*
Norman Biggs (LSE): *Don't panic - send for a mathematician: memories of Bill Tutte*
Tony Gardiner (independent): *Alison who?*

10.00-11.00. Live Q&A with Richard, Norman and Tony. Chair Isobel Falconer

Session 2: Mathematical Crises
Henrik Kragh Sørensen & Anton Suhr (Copenhagen): *Bridging practices in analysis during a time of crisis: Abel's representations of elliptic functions*
David Robertson (Independent): *Gödel's incompleteness theorem, and the reaction to it*
Michael Friedman (Humboldt, Berlin): *Metaphorical reactions to the "crisis of intuition"*

13.00-14.00 Live Q&A with Henrik, Anton, David and Michael. Chair Troy Astarte

Session 3: Responses of the mathematical community
Stefano Gulizia (Polish Institute of Advanced Studies): *"Truth" and "testimony" in the 17th century: a Keplerian-artisanal view*
Brigitte Stenhouse (Open University): *Conjuring the "spirit of Laplace": translation as an answer to mathematical crisis*
Michael Barany (Edinburgh): *How to reschedule an International Mathematics Conference postponed due to world events, 1939-1950*
Peggy Kidwell (Smithsonian): *Mathematical instruments in times of crisis*

16.30-18.00: Live Q&A with Stafano, Brigitte, Michael and Peggy + reflections on the day. Chair Mark McCartney

Abstracts (in programme order)

Richard Simpson (Independent): *Paolo Ruffini(1765-1822) - A Forgotten Talent.*

Paolo Ruffini is now famous for being the first to propose that quintic equations could not be solved in radicals. The years of Ruffini's life were a time of great national upheaval in

Northern Italy. His home city of Modena , originally a Dukedom, swung politically between French and Austrian control. As well as studying mathematics at Modena University, he trained as a medical doctor. Ruffini rose rapidly through the ranks of academe in Modena being appointed as Professor of Mathematics in 1791. Throughout the period Ruffini struggled to reconcile his desire to work actively both in mathematics and medicine with outside forces trying to involve him politically, as some of his near relations were. A man of strong religious faith he refused to swear an oath of allegiance to the new Cisalpine Republic set up by Napoleon, considering that oath to be against his strong catholic principles. This action cost him his chair and he retired to practise medicine again. However it was during this period that he found the time to return to mathematics and wrote his most famous work on the quintic. Subsequently after the fall of Napoleon he was appointed Rector of the University, a post in which he exercised considerable acumen against a constantly shifting political scene and was highly regarded. So much so that he was elected to the newly formed Italian National Academy of Sciences, known as "The Forty" and eventually became its President. Ruffini's mathematical ideas were not only revolutionary but were difficult for most to understand. Lacking endorsement from better known mathematicians such as Lagrange, together with a general unwillingness at that time to accept that a solution to the quintic problem did not exist, Ruffini's work faded to obscurity for many years.

This talk will explore Ruffini's life and try to put some light on his many achievements.

Norman Biggs (LSE): ***Don't panic – send for a mathematician: Memories of Bill Tutte***

Bill Tutte's codebreaking work in World War II is now well-known, and acknowledged for its national significance. But for most of his life he enjoyed the obscurity usually bestowed upon mathematicians, even those who are the undisputed leaders in their field. I was fortunate to know him well from about 1970 onwards, during which time he gradually emerged from the cloisters of the academy to become a national treasure. For some reason this shy and retiring man seemed to feel comfortable with me, and I was privileged to interact with him as a human being, rather than a character in a Hollywood movie. Alongside my personal recollections of Tutte the man, I shall describe how his wartime achievements were gradually revealed, and his reaction to that.

Tony Gardiner (Independent): ***Alison who?***

The 1942 Part III Mathematics Class at Cambridge consisted of five students. Four of them went on to become world-class applied mathematicians and mathematical physicists. The fifth more than held her own. So who was she? And what happened to her?

Henrik Krage Sørensen (Copenhagen) & Anton Suhr (Copenhagen): ***Bridging practices in analysis during a time of crisis: Abel's representations of elliptic functions***

During the first decades of the nineteenth century, the practice of analysis was radically transformed from one epitomized by Leonhard Euler and premised on the syntactic manipulation of explicit expressions to one epitomized by Augustin-Louis Cauchy and explicitly replacing the formal generality of the old one with numerical equality and carefully crafted criteria of convergence.

In the midst of this transition, the young Norwegian mathematician Niels Henrik Abel (1802–1829) produced important results in algebra, the foundations of analysis, and the study of elliptic functions which he helped transform into a center-piece of nineteenth century analysis.

At the same time an ardent follower of Cauchy on matters of rigor in the foundations of analysis, Abel never seemed to apply the same considerations to his study of elliptic functions. This provides us with a lens through which to study the changing and bridging of practices in mathematics during this important period. Thus, if the rigorization and arithmetization of analysis — understood as a change of practices — is to be approached as a possible (Kuhnian) change of paradigms, Abel could be viewed as a mediator through the crisis when existing standards and values were being re-negotiated.

In this presentation, we reconstruct some of Abel's own arguments in order to analyse his derivations of infinite representations for these new elliptic functions. This provides us with two novel historical insights: On the one hand, they allow us to peek into Abel's analytical toolbox which — unsurprisingly — comes out as skillfully Eulerian in nature. And on the other hand, viewing these sections of Abel's seminal paper through this lens of crisis offers an interpretation that they served (also) as means of bridging the changing practices, making the new objects accessible and acceptable to practitioners of the Eulerian practice.

David Robertson (Independent): ***Gödel's incompleteness theorem, and the reaction to it***

The silence breaks - "It's all over"; these were the words of John von Neumann. The year is 1930 and a young logician named Kurt Gödel has just given an address on his First Incompleteness Theorem, demonstrating - with an ingenious method of numeric representation - that there existed statements which evade proof of truth or falsehood within consistent arithmetic systems. Around the same time, David Hilbert had announced his retirement, re-iterating that in mathematics there is 'no Ignorabimus' - no unknowables. This mantra had defined the formalist mathematical attitude for the last 20 years, and had more generally propagated a powerful optimism in the mathematical community. In a single speech, Gödel had shown the fallacy of this movement: the limitations of proof, the distinctness of mathematics from pure logic, and the 'essential incompleteness' of consistent systems capable of arithmetic. The rifts of this realisation would 'remain visible far in space and time'. I will describe the general motion of the mathematical community before Gödel's proof before underlining the important elements in a proof sketch of Gödel's First

Incompleteness Theorem. The remainder of my talk will be occupied by a consideration of the impact Gödel's theorems had on the community and on the philosophy of mathematics.

Michael Friedman (Humboldt University, Berlin): ***Metaphorical reactions to the "crisis of intuition"***

The "crisis of intuition" in mathematics of the end of the 19th century and the beginning 20th century was prompted (also) by the appearance of "monstrous" functions, which were considered as contra-intuitive; famous examples of these functions were the Weierstraß function or the Peano curve. Hans Hahn, in his lecture "The crisis of intuition" ["Die Krise der Anschauung"] from 1933,[1] presented this crisis, the mathematical objects that created it, as well as his proposed solution (namely, the purely logical definition of mathematics). Due to the philosophical and historical inaccuracies and fallacies of Hahn's talk, the lecture was heavily criticized, both shortly after its presentation, as well as by Klaus Volkert in 1986.[2]

The aim of my talk is not to recount the above (well justified) critic, but rather to examine how Hahn and his colleagues described this crisis in 1933. The lecture was given in the framework of a series of five lectures, which was held in Vienna, carrying the title "Crisis and new construction in the exact sciences" [Krise und Neuaufbau in den exacten Wissenschaften]. Which metaphors did the various lecturers, belonging to the Vienna Circle, employ, when reacting to this crisis? Did one offer the rebuild mathematical foundations (as the title of the series implies), using the well-known architectural metaphor, or rather emphasize a less unifying image of mathematics, as a domain which becomes more and more splintered? Were other metaphors used, and which image of mathematics was transmitted with them?

Stefano Gulizia (Polish Institute of Advanced Studies): ***"Truth" and "testimony" in the 17th century: A Keplerian-artisanal view***

This paper suggests that layered ontology and geometrical constructivism are important aspects of Kepler's method. After summarizing the Renaissance debate on the reliability of mathematical data and astronomical hypotheses, the exposition concentrates on the *Mysterium cosmographicum* (Tübingen 1597) and its celebrated Tabula III, a woodcut with nested solids, proposing an alternative reading. The paper also documents the response to Kepler in the mathematical community of Northern Germany and the Baltic area.

[1] Hans Hahn, "Die Krise der Anschauung". In: *Krise und Neuaufbau in den exakten Wissenschaften*. Leipzig und Wien: Franz Deuticke, 1933, p. 41–64.
[2] Klaus Volkert, *Die Krise der Anschauung*, Göttingen: Vandenhoeck & Ruprecht, 1986.

Brigitte Stenhouse (Open University): ***Conjuring the "spirit of Laplace": translation as an answer to mathematical crisis***

In early-19th-century Britain, mathematics was seen to be in crisis. From John Toplis to John Playfair, and the well-known Analytical Society of Cambridge, accounts of the decline of British mathematics were abundant. Whilst some attributed the decline to an over-zealous reverence of Newton, others pointed towards the inferiority of 'synthetic' or 'geometrical' reasoning compared to the 'analytical' or 'algebraic' methods used in continental Europe.

One of the key texts held up as an example of the inferiority of British mathematics compared to its French counterpart was Pierre-Simon Laplace's *Traité de Mécanique Céleste* (5 vols, 1799-1825), which was said to reduce the "whole theory of astronomy into one work" and to be incomprehensible to all but a handful of British readers (Playfair, 1808). By 1825 three partial English translations of *Mécanique Céleste* had been published, each with unique additions and amendments aiming to make the work accessible to a reader with a 'British' mathematical education. Nevertheless, in the late 1820s it was still felt that a good English translation was lacking, and two authors, the Scottish Mary Somerville and the American Nathaniel Bowditch, produced translations which differed widely in style both from each other and from their predecessors.

By considering these five translations of Laplace's *Mécanique Céleste* side by side, we will investigate how different perceived causes of the inferiority of British mathematics led to different methodologies of translation.

Michael Barany (Edinburgh): ***How to Reschedule an International Mathematics Conference Postponed Due to World Events, 1939-1950***

The 1940 International Congress of Mathematicians was officially postponed in September 1939, after European conflict finally turned from a fundraising rationale to an insuperable obstacle for its American organizers. A world war made the Congress untenable for the next half decade, but it would take a half decade further for the for the intended international meeting to take place. I will examine how the American and international mathematics communities responded to the outbreak of war, how they sustained the aim of an international meeting with no date in sight, how they manoeuvred for control of postwar mathematics, what prompted the choice of August 1950 for a new International Congress of Mathematicians, why it took mathematicians so long to resume their international meetings, and what this all meant for mid-twentieth century mathematics.

Peggy Kidwell (Smithsonian): ***Mathematical Instruments from Times of Crisis***
The objects shown in the exhibits or stored in the cabinets of museums and mathematics departments – or used in mathematical research and teaching – rarely convey a sense of crisis. However crises create new roles, mix cultures, bring about new needs, make unexpected use of time (and sometimes create boredom), and generate fear, All of these

changes have shaped even these now-placid objects. Careful examination of a few instruments as part of the lives of the mathematicians and others associated with them suggests such connections.

Thus, at the time of the American Revolution, geographer Simeon de Witt moved to New Jersey from his native New York and became Surveyor General for the Continental Army. When he wasn't drawing maps for the forces, he drew a detailed handheld star map (such things could not be imported). During the Napoleonic wars, French mathematician and soldier Victor Poncelet took part in Napoleon's ill-fated attack on Russia. Captured and imprisoned by the Russians, he not only continued his research on projective geometry, but became familiar with the Russian abacus. Intrigued by the possible pedagogical uses of this instrument, he had much to do with the introduction of the teaching abacus or numeral frame in French schools and, indirectly, its adoption in the United States. Sometimes crises arose more slowly. The U.S. Constitution requires a decennial Census of the population. By the 1880s, the population had grown such that tabulating the results took an unacceptable length of time. To avoid a constitutional crisis, the Bureau of the Census encouraged citizens to develop new machinery for counting records. Herman Hollerith was among those who took up the challenge. Hollerith tabulating machines would acquire a place in business as well as government – his firm was one of the forerunners of IBM. Of course, needs of a crisis also affected people more directly involved in mathematics. Thus, at the time of World War II, Grace Murray Hopper, who had her doctorate in mathematics from Yale University and was a mathematics professor at Vassar College, enlisted in the U.S. Navy and was assigned to programming the ASSC Mark I, an electromechanical computer built by IBM and operated at Harvard University. This and other wartime computer projects did much to make programmable computing devices a practical reality. Hopper herself never returned to mathematics. She also adopted not only programming techniques but the language associated with it – giving her own spin to existing terms like "computer bug."

Finally, and more seriously, mathematical instruments reflect the enduring fears associated with times of crisis. The potential effects of nuclear weapons are summarized in this circular slide rule, developed in New Mexico for the U.S. Atomic Energy Commission. The instrument grimly reveals how those at varying distance from the explosion of a bomb will suffer.